REMARKS

Petition for Extension of Time Under 37 CFR 1.136(a)

It is hereby requested that the term to respond to the Examiner's Action of May 6, 2008 be extended three months, from August 6, 2008 to November 6, 2008.

The Commissioner is hereby authorized to charge the extension fee and any additional fees associated with this communication to Deposit Account No. 50-4364.

Claims 11 to 16, 18 to 48, and 50 to 64 are pending in the application, and the Examiner rejected all claims.

Objection to the Specification under 35 USC 132(a)

On page 2 of the Office Action, the Examiner has objected to the specification as introducing new matter into the disclosure. Specifically, the Examiner has objected to the newly added paragraphs concerning the newly added figures submitted with Applicant's amendment dated April 30, 2007, as not being fully supported by the original disclosure. As a result, this amendment was not entered, and the drawings were not accepted.

While the applicant believes the original disclosure fully supports the amended specification, to further prosecution applicant withdraws the request to add the paragraphs and the added figures to the specification of the application as submitted with Applicant's amendment dated April 30, 2007. Therefore, the amendment to the specification is cancelled and the objection to the Specification under 35 USC 132(a) is overcome. Since the cancelled matter related to claims 24, 27, 30, 55, 58 and 60, these are now cancelled solely for the sake of overcoming the objections relating to this issue. It is explicitly stated herewith, that the applicant does not waive the scope of protection of the remaining claims being extended under the doctrine of equivalents by the subject matter of the cancelled claims.

Claim Rejection under 35 U.S.C. 112, first paragraph.

On page 3 of the Office Action, the Examiner rejected claims 11-16, 18-48, and 50-64 under 35 U.S.C. §112, first paragraph, as failing to comply with the enablement requirement.

The Examiner states:

> "Claims 1 (presumably 11) and 41 have been amended to include the phrase "optical system generating a Fourier or inverse Fourier transform of the hologram encoded on the hologram-bearing medium at the image plane of the light source". It is not clear how could the optical system is capable of generating "Fourier transform" of the hologram. Does this mean the hologram is a Fourier transform hologram or not? If the hologram is a Fourier transform hologram, then the Fourier transformation is not generated by the optical system rather is the hologram itself being encoded as Fourier transform hologram. Judging from the Figures of the instant application, it appears this optical system is functioned to provide collimating light beam to illuminate the hologram. It is really not "generating Fourier transform of the hologram". Further, Fourier transform and inverse Fourier transform are inverse function to each other. While the optical system is demonstrated to inverse Fourier transform the light from the light source to provide collimating beam for illuminating the hologram the specification fails to teach how does the optical system to provide Fourier transform to the light from the light source. The claims therefore are not enabling."

The Examiner has correctly stated that "the optical system is demonstrated to inverse Fourier transform the light from the light source". The illuminated hologram is then transformed by another inverse Fourier transform into the image plane of the light source, see paragraph [0032], 2nd sentence of the instant application: "If a hologram-bearing medium 3 is inserted, it is reconstructed in the viewing plane 4 as an inverse Fourier transform". This is consistent with the last sentence of paragraph [0031] of the instant application, where it is stated that "The viewing plane 4 corresponds with the Fourier plane of the inverse transform of the video hologram with the diffraction orders". The only reason a "direct" or "inverse" Fourier Transform was claimed was that, seen from a mathematical point of view, the optical system performs a "direct" or an "inverse" Fourier Transform, which depends on the

definition of the coordinate system/axes for such a system (A direct Fourier Transform differs from an inverse Fourier Transform only by a minus sign of the exponent appearing in the integral). But this is can be altered from a "direct" Fourier Transform to an "inverse" Fourier Transform by simply defining a different set of coordinate axes. Therefore, claims 11 and 41 have been amended such that the respective feature (i) now reads as:

> "the optical system generating an inverse Fourier transform of the hologram encoded on the hologram-bearing medium at the image plane of the light source".

Feature (iii) has been amended accordingly. This is clearly disclosed in the instant application in the passages cited above and this is also the understanding of the examiner. Therefore, this objection is overcome. It is noted, that the applicant merely amended the claim to finally overcome this objection. It is explicitly stated herewith, that the applicant does not waive the scope of protection of amended claims 11 and 41 for the removed alternative under the doctrine of equivalents, even though it is not explicitly claimed.

The Examiner states:

> "The specification fails to provide the enablement of Fresnel transformation of the hologram and not the Fourier transformation of the hologram as recited in the claim 16 in particular claim 11, its based claim, has been amended to explicitly stated the optical system is to generate Fourier transform of the hologram. This seems to be contradicting to each other. Even if Fresnel transformation is a general case of Fourier transformation, Fresnel transformation CANNOT be ruled as "not Fourier transformation"."

The statement of the Examiner "even if Fresnel transformation is a general case of Fourier transformation, Fresnel transformation CANNOT be ruled as "not Fourier transformation"" is true, if this statement were the sole mathematical statement of claim 16. But this is not the case here, since claim 16 claims that "the holographic reconstruction representing the three-dimensional scene is described by the Fresnel transform of the hologram". In other words, it is the three dimensional light interference representing the

three-dimensional scene, which is described by the Fresnel transform of the hologram being encoded in the hologram-bearing medium. The three dimensional light interference representing the three-dimensional scene is what is actually seen by the observer. The three-dimensional scene is located between the hologram-bearing medium and the image plane of the light source, as stated in paragraph [0034] of the instant application: "The actual three-dimensional scene 6 is indicated in the form of a circle inside the bundle of rays of the 1st diffraction order. The scene is thus located inside the reconstruction frustum which stretches between the hologram-bearing medium 3 and the viewing window 5". The image plane of the light source is identical to the viewing plane in which the viewing window and the eye of the observer are located.

It is therefore true to state that the three-dimensional scene being actually seen by the observer is not the Fourier transformation the hologram being encoded in the hologram-bearing medium. This has not to be misunderstood with the fact that a Fourier transformation the hologram being encoded in the hologram-bearing medium is optically generated by the optical system of the reconstruction device at the image plane of the light source. As it is stated in the description of the instant application in various places, this is actually performed by the optical system and can't be prevented. However, the light distribution at the image plane of the light source (i.e. in the viewing plane in which the viewing window and the eye of the observer are located) enters the eye of the observer since the light continues to propagate. However, this – the Fourier transformation the hologram – is not the three dimensional light interference representing the three-dimensional scene being actually seen by the observer.

Claim 16 has now been amended to make this context clear. Therefore, the objection is overcome.

The Examiner states:

> "The specification fails to disclose how does the virtual light source is generated. (The applicant is respectfully noted that the proposed amendment to the specification and proposed new drawings filed on April 30, 2007 have NOT been entered. So the arguments based on these non-entered amendments to the application are not persuasive to overcome the rejections.)"

This relates to claims 24 and 27 which now have been deleted solely for the sake of moving the remaining claims towards allowance. The applicant expressly states herewith that it does not waive the scope of protection of the subject matter of claims 24 and 27 under the doctrine of equivalents, even though it is no longer explicitly claimed.

The Examiner states:

> "The specification fails to disclose how the light source is being positioned by the mechanical or electronic displacement or by movable mirrors."

This relates to claim 30 which now has been deleted solely to move this application to allowance. The applicant does not waive the scope of protection of the subject matter of claim 30 under the doctrine of equivalents, even though it is not explicitly claimed.

Claim Objections

On page 4 of the Office Action, the Examiner objected to claim 50 as being of improper dependent form for failing to further limit the subject matter of a previous claim. Claim 50 has been cancelled by this amendment.

Also on page 4, the Examiner objected to claims 1-16, 18-48, and 50-64 for various informalities.

The Examiner states:

"(1). It is not clear how could the optical system to either generating Fourier or inverse Fourier transformation to the hologram. Since they are inverse to each other, so it is not clear which one is really referred here?"

This relates to claims 11 and 41 and has been addressed above.

The Examiner states:

"(2). Claim 16 is contradicting to amended based claim, claim 11. The amended claim 11 recites explicitly to have optical system to generate Fourier transform of the hologram but claim 16 recites "not Fourier transform of the hologram" that is contradicting to each other."

This has been addressed above.

The Examiner states:

"(3). It is not clear what is considered to be the 'function of the periodicity interval of the hologram' as recited in claim 18."

It is a fundamental fact that in the optical setup as claimed by claims 11 and 41 (especially because of the features (ii) and (iii)) that the reconstruction of the three dimensional scene is based on the physical phenomenon of diffraction. The pitch of the hologram-bearing medium and the wavelength of the light being used determine the diffraction angle of the light passing the hologram-bearing medium and being diffracted by the hologram-bearing medium. Example: for a given hologram-bearing medium comprising a pixel pitch of e.g. 30 μm and for a wavelength of e.g. 488 nm, the diffraction angle α is a constant according to the formula: $\sin \alpha = m \lambda / p$ (wherein m = number of diffraction order, λ = wavelength of the light, p = pixel pitch). In this example, the diffraction angle is about 1 degree. If diffraction occurs, there are automatically higher order representations of the diffraction pattern / reconstruction, i.e. diffraction orders, as stated e.g. in paragraph [0032] of the instant application:

"The hologram-bearing medium 3 with periodic openings creates equidistantly staggered diffraction orders in the viewing plane 4,...."

These are well known fundamental relations of optics. It appears that this is also the understanding of the examiner, because the examiner states (even though in another context) in the second paragraph on page 6 of the office action "different diffraction orders of diffracted light are commonly spatially separated".

The periodicity interval as referred in the application is located in the image plane of the light source – i.e. in the viewing plane 4 – and is (because of the diffraction angle) directly depending on the pixel pitch and on the distance between the hologram-bearing medium and the image plane of the light source. Its maximal extend is given by the geometric formula: $P = \lambda D / p$ (wherein P = maximal size of the periodicity interval; λ = wavelength of the light, D = distance between the image plane of the light source and the hologram-bearing medium (being the focal length of the lens) and p = pixel pitch). This is because the "higher diffraction orders" are equidistantly staggered in the viewing plane 4, as stated in paragraph [0032] cited above. This becomes also apparent from paragraph [0007] of the instant application (letters relating to the formula mentioned above added in square brackets):

> "As is generally known, in Fourier holograms the scene is reconstructed as a direct or inverse Fourier transform of the hologram in a plane. This reconstruction is continued periodically at a periodicity interval, the extension [P] of said periodicity interval being inversely proportional to the pitch [p] in the hologram"

According to the example mentioned in paragraph [0033] of the description of the instant application,

> "The dimension of the reconstruction was chosen here to correspond with the dimension of the periodicity interval of the 1st diffraction order in the viewing plane 4."

This discloses in this example the relation between the diffraction order and the periodicity interval as well as its extension.

In the following, the relation between the size of the observer window and the periodicity interval is explained by citing relevant passages of the application as originally filed:

Paragraph [0014] discloses:

> "The maximal extent of the viewing window corresponds to the periodicity interval in the plane of the inverse Fourier transformation in the image plane of the light source."

With this sentence, the "maximal extent of the viewing window" is connected to or set into relation with "the periodicity interval" (in the viewing plane 4 = the image plane of the light source). In other words, the size of the viewing window is smaller than or equal to the size of the periodicity interval. This is the reason why it might be useful to calculate the size of the viewing window, depending on the current application of the reconstruction device.

Something similar can be derived from paragraph [0035] of the description of the instant application, namely from the sentence:

> "This reconstruction allows the size of the viewing window 5 to be constrained by the periodicity interval".

This explains the function of the periodicity interval of the hologram.

By amending claim 18 with "by a computing means" it should be clear which component performs the calculation of the size of the viewing window. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the objection of claim 18.

The Examiner states:

> "(4). The phrase "the viewing window is smaller than the hologram bearing medium" (noted the amendment to claim 19 is not proper, which lacking the proper deletion and underlined for the alteration), recited in claim 19 is confusing since it is not clear how does the viewing window comparing to the bearing medium?"

Claim 19 has been amended to address the examiner's concerns. Claim 19 now recites as: "the size of the viewing window is smaller than the size of the hologram-bearing medium". This makes clear that it the size in the meaning of the outer dimensions of the two elements, the viewing window and the hologram-bearing medium. Accordingly, the Examiner is respectfully requested to reconsider and withdraw the objection to claim 19.

The Examiner states:

"(5). The phrase "and/or" in claim 35 is confusing and indefinite."

Claim 35 has been amended to address the Examiner's concerns by amending the passage "the phase and/or amplitude" into "the phase or the amplitude or the phase and the amplitude". Accordingly, the Examiner is respectfully requested to reconsider and withdraw the objection to claim 35.

The Examiner states:

"(6). It is not clear how does the "hologram-bearing medium controls phase, amplitude or phase and amplitude". Firstly, the phase and amplitude of what? Secondly how does the hologram medium control it? Does this mean the hologram encoded on the medium controls the phase and amplitude or the medium by itself controls the phase and amplitude?"

The hologram-bearing medium controls phase, amplitude, or phase and amplitude of the illumination light of the optical system of the reconstruction device. This becomes apparent e.g. from paragraph [0006] of the instant application, especially from the sentence "The wave fronts emerging from the openings converge in object points of the three-dimensional scene before they reach the viewer." The medium controls it by the fact that the hologram is encoded into the hologram-bearing medium. Therefore, amended claim 35 now reads as:

"The method of Claim 11, wherein the holographic reconstruction is in color, and wherein the hologram-bearing medium is composed of cells arranged in a regular pattern with at least three openings per cell, representing the three primary colors, the phase or the amplitude or the phase and the

amplitude of light from the light source being controllable by said openings by encoding the hologram into the hologram bearing medium, and said openings being encoded individually for each primary color."

Accordingly, the Examiner is respectfully requested to reconsider and withdraw the objection to claim 35.

Claim Rejection under 35 U.S.C. 103(a)

The Examiner Has Not Established a Prima Facie Case of Obviousness

KSR (*KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 82 USPQ2d 1385 (2007) requires that an Examiner provide "some articulated reasoning with some rationale underpinning to support the legal conclusion of obviousness." Further, an Examiner must "identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does," In addition, the Examiner must make "explicit" this rationale of "the apparent reason to combine the known elements in the fashion claimed," including a detailed explanation of "the effects of demands known to the design community or present in the marketplace" and "the background knowledge possessed by a person having ordinary skill in the art."

The Examiner has not met these requirements.

The subject matter of amended independent claims 11 and 41 (and thus all claims depending therefrom) is not obvious in view of Payne.

On page 5 of the Office Action, the Examiner rejected claims 11-6, 18-48, 50 and 51-64 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application Publication No. 2004/0263930 to Payne.

Payne neither explicitly nor implicitly discloses the features of paragraphs (ii), (iii), or (iv) of claim 11. The applicant has repeatedly presented arguments , in prior replies,

explaining that some or all these features are neither disclosed in Payne nor in any other cited prior art documents. It is applicant's position that the Examiner has not demonstrated that Payne or any other prior art document discloses these features. Before advancing this application to the Appeal process, applicant presents, again, reasons why Payne does not disclose or suggest the features of the cited paragraphs of claim 11.

On page 6 of the office action, the Examiner states:

> "A wavefront will certainly be generated from the illumination of the hologram and implicitly that an observer can view the reconstruction of the hologram through a *viewing window* at the image plane of the light source through the optical system. Payne further teaches that the hologram can further be Fourier transformed by reply optics (4 and 5, Figure 1, please see paragraph [0009])"

In Payne, it is the holographic reconstruction representing the three-dimensional scene that is located at the image plane of the light source, please see Payne as cited by the Examiner in paragraph [0009]: "A 3D image 6 appears to the viewer to be located in the image/Fourier plane of the replay optics".

In Payne, the method of the operation of the reconstruction device and the setup of the optical system is significantly different to the one being claimed according the present invention as defined by claim 11. Referring to Fig. 1 and the relevant detailed description (especially in paragraph [0009]) of Payne, Fig. 1 does not disclose the position of the viewer's eye in relation of the focal plane of the replay optics (4, 5). In fact, nowhere in Payne is this disclosed. Specifically, Payne does not disclose that:

> "the viewing window (being provided in the image plane of the light source, the image plane of the light source being identical to the image/Fourier plane of the replay optics) being the location where an observer places at least one eye to view the holographic reconstruction representing the three-dimensional scene" (feature (ii) of claim 11)

Since this is explicitly claimed in claim 11, and since Payne neither teaches nor suggests the claimed features, Payne does not render obvious the claimed invention.

The Examiner states on page 12 of the office action (emphasis by underlining added):

> "In response to applicant's arguments which states that the cited Payne reference does not teach to provide viewing window in the image plane of the light source" the examiner respectfully disagrees. Firstly, the 3D image reproduced is at the image plane of the light source as applicant indicates above in paragraph [0009] of Payne. So 3D image is viewed at the image plane of the light source. Secondly, since the hologram is direction selective, which means reproduced hologram can only be viewed at the direction determined by the recording beams of the hologram, certain viewing region or window is implicitly determined by the hologram."

The underlined statement of the Examiner is only correct in the context that the 3D image is located at the image plane of the light source (what is disclosed by Payne as the examiner states correctly by the sentence before the underlined sentence) and is viewed from a location of the observer's eyes being spaced apart from the image plane of the light source. The statement surely can't be meant in the sense that the 3D image is viewed by locating the observer's eyes at the image plane of the light source, because the 3D image is located at the image plane of the light source. The 3D image can't be viewed by locating the observer's eyes at the same position of the 3D image, because the normal viewing distance of human eyes is about 20 cm.

Feature (iii) of claim 11 is not disclosed in Payne either, because Payne is absolutely silent with regard of the encoding of the hologram on the hologram-bearing medium. The hologram-bearing medium (SLM) is encoded in Payne. However, it is not "encoded to reconstruct a given object point, when seen from the viewing window, in only a limited region of the hologram-bearing medium, so that the inverse Fourier transform in the viewing window is restricted to a single diffraction order of the light diffracted by the hologram-bearing medium" (feature (iii) of claim 11). Since the given object point is not seen from the viewing window in Payne, there is no limited region of the hologram-bearing medium into which the hologram for the given object point is encoded such that the inverse Fourier

transform (of this limited region) in the viewing window is restricted to a single diffraction order of the light diffracted by the hologram-bearing medium. Therefore feature (iii) of claim 11 is not disclosed in Payne et al.

In Payne, the holographic reconstruction of the three-dimensional scene is located in or around the focal plane of the replay optics. Therefore, Payne does not disclose that the holographic reconstruction is located within a reconstruction frustum stretching between the hologram-bearing medium and the viewing window, where the viewing window is the location where an observer places at least one eye to view the holographic reconstruction representing the three-dimensional scene according to feature (iv) of claim 11.

The same arguments hold true with respect to U.S. Patent No. 7,053,925 B2 to Payne et al. Like Payne '930, Payne '925 neither explicitly nor implicitly discloses the features of paragraphs (ii), (iii), or (iv) of claim 11. The setup of the optical system in Payne '925 is fundamentally different than the one being claimed with claim 11. Referring to Fig. 1 and the relevant detailed description (especially in the second-to-last paragraph of column 7) of Payne '925, Fig. 1 does not disclose the position of the viewer's eye in relation of the focal plane of the replay optics (2).

The position of the viewer's eye is in relation of the focal plane of the replay optics (21) is disclosed in Payne '925 in detail in Fig. 2 and explained in the last paragraph of column 8 (additional emphasis added):

> "Figure 2 shows a cross-section of a schematic of a CGH based display system. Light passes through the CGH (20), the replay optics (21) and forms the three-dimensional 30 image around the focal plane (22). The three-dimensional image will typically be contained within a diamond shaped (polyhedral in three-dimensions) volume (23). An eye with a pupil is shown (24). Only light arising from the contributing region (25) reaches the eye pupil. The extremities of the contributing region are defined by the intersections of the light rays (26) that pass through the extremities of the image and 35 the eye pupil. It can be seen that only a limited angular cone of light (28) arising from a single pixel (27) in the CGH reaches the eye pupil.

> Another feature of CGH based displays is the viewing region, the bounds of which are shown by dashed lines (29). **This is the region in which the eye needs to be located in order to see the whole image**."

As stated in the last sentence of this paragraph, the eye of the observer needs to be located in the region delimited by the dashed lines (29) in order to see the whole image. If the eye of the observer has to be (or needs to be) located in this region in order to see the whole image, it is impossible and it is not disclosed in this reference that the same observer's eye is located in the focal plane (22) of the replay optics where the three-dimensional (30) image is formed. The Examiner will appreciate that the focal plane (22) is spaced apart from the viewing region being delimited by the dashed lines (29). There is no explicit and also no implicit disclosure of this feature in of Payne '925.

But even if the observer would locate his eyes in the focal plane (22) of the replay optics, the observer would not be able to see the holographic reconstruction representing the three-dimensional scene. This is because he will only be able to see the light distribution in the focal plane (22) of the replay optics but no image or the holographic reconstruction of the three-dimensional scene, since the normal viewing distance of human eyes is about 20 cm.

Especially with regard to feature (iii) of claim 11, the Examiner is asked to also consider the arguments submitted in the response filed on January 16, 2008, beginning on page 16 and headed 'Additional Argument'. In conventional holography, the encoding needed to reconstruct a given object point is distributed across the *entire* hologram-bearing medium. There is no suggestion in Payne that it departs from this standard approach.

The addition of the Klug and/or Gutjahr do not render the claimed invention obvious. None of these references, alone or in combination, teach or suggest the claimed elements that are lacking in Payne. The elements are recited in each claim. Accordingly, the Examiner is

respectfully requested to reconsider and withdraw the rejection of the claims under 35 USC §103.

Applicant, therefore, requests that this rejection be withdrawn and independent claims 11 and 41,and all claims depending therefrom be allowed.

Applicant, therefore, requests that this rejection be withdrawn and the claims be allowed.

The Double Patenting Rejections

On pages 8 through 11 of the Office Action, the Examiner made various provisional obviousness-type double patenting rejections of Claims 11-6, 18-48 and 50-64, as follows:

Over claims 1-22 of copending Application No. 11/427,629

Over claims 1-21 of copending Application No. 11/313,989

Over claims 1-22 of copending Application No. 11/427,638

Over claims 1-22 of copending Application No. 11/427,645

Over claims 1-23 of copending Application No. 11/427,649

Over claims 1-23 of copending Application No. 11/427,655

Over claims 1-19 of copending Application No. 11/937,991

The Examiner additionally made an obviousness-type double patenting rejection of Claims 11-6, 18-48 and 50-64 over claims 1-19 of U.S. Patent No. 7,315,408.

Applicant will file one or more Terminal Disclaimers to overcome these rejections will be filed upon an indication of allowable subject matter.

Summary

In view of the foregoing amendments and remarks, applicant respectfully requests entry of the amendments, favorable reconsideration of the application, withdrawal of all rejections and objections and that claims 11-6, 18-48 and 50-64 be allowed at an early date and the patent allowed to issue.

The Commissioner is hereby authorized to charge the extension fee and any additional fees associated with this communication to applicant's Deposit Account No. 50-4364.

Respectfully submitted

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Date

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